TABLE 3. MEASURES OF SPENDING FOR LARGE CIVILIAN R&D PROJECTS
(Budget Authority, in billions of current dollars)

Year	Inventory of Large Projects[a]	Largest Three Projects[b]	Fields of Research[c]	R&D Plant[d]
1980	3.6	2.6	5.6	1.0
1981	4.0	3.0	6.0	0.9
1982	3.6	2.5	5.5	0.7
1983	5.0	4.0	4.7	0.6
1984	1.6	0.5	5.1	0.8
1985	1.9	0.6	5.4	0.9
1986	1.8	0.5	5.4	0.9
1987	2.1	0.7	5.7	1.0
1988	2.2	0.7	6.2	1.2
1989	2.9	1.2	7.5	1.3
1990	4.0	2.1	9.4	1.9
1991	4.6	2.4	10.9	1.8
1992	5.7[e]	2.9[e]		
1993	6.6[e]	3.7[e]		
1994	7.3[e]	4.6[e]		
1995	8.0[e]	5.4[e]		
1996	8.4[e]	5.9[e]		

SOURCE: Congressional Budget Office.

a. Includes nondefense science projects costing more than $25 million in 1984 dollars of budget authority.

b. Consists of the three largest projects in the inventory in any given year, measured in budget authority.

c. Includes areas of research dominated by large instruments, measured in budget authority.

d. Includes federal spending on structures and large equipment, measured in obligations.

e. Requested in the President's budget for 1992.

the control of policymakers, rather than outlays that reflect nonpolicy developments such as delays caused by technical and contractual factors. (The major exception is the R&D structures measure, for which data are available only in obligations.)

The CBO Inventory of Large Projects

CBO assembled a list of 80 large R&D projects and facilities that built upon a list made by William C. Boesman.[7] The Boesman inventory includes science and engineering research projects requiring complex and expensive equipment and costing over $25 million in 1984 dollars. It is based on research disciplines, such as astronomy or biology. By contrast, CBO's inventory is focused on the budget functions for General Science, Space and Technology (function 250) and Energy (function 270). These budget functions include most of the spending for science and technology by the Department of Energy (DOE), the National Aeronautics and Space Administration (NASA), and the National Science Foundation (NSF). Health research, the largest part of civilian R&D not included in functions 250 and 270, is for the most part treated separately (see box).

Since the public debate is largely focused on the role of big projects in civilian R&D, CBO excluded big projects in both the Department of Defense and the defense-nuclear R&D portion of the DOE budget. CBO's inventory also differs from Boesman's in its treatment of NASA projects. To recognize the substantially higher cost of scientific and technical efforts in space, CBO's inventory includes the space shuttle in its development phase and only the largest or "facilities class" projects as NASA refers to them.

A drawback to the inventory approach is that it includes general-purpose equipment with wide applications--for example, supercomputers--that facilitate both large and small science and technology efforts. The threshold level of $25 million (in 1984 dollars) Boesman used, which was adopted for much of the CBO inventory, can also be criticized as too low and arbitrary. However, the three largest projects measure compensates for the threshold problem by excluding many R&D projects that are clearly recognized as large R&D efforts.

NSF Projects. The NSF projects include, but are not limited to, the Boesman inventory of big-science instruments. The annual data cover spending on these facilities during 1980 through 1995 and include both construction and operation costs. CBO projected spending on these projects forward to 1996 (see Table 4).

---

7. William Boesman, *World Inventory of "Big Science" Research Instruments and Facilities*, Congressional Research Service (December 1986), reprinted in U.S. House of Representatives, Committee on Science and Technology, *Science Policy Study; Background Report No. 4 (1987).*

The Human Genome Project

The Human Genome Project (HGP) is a 15-year program to assemble the genetic master plan of human beings, carried on jointly by the National Institutes of Health (NIH) and the Department of Energy (DOE). NIH's rationale for participation is that the effort will provide "new strategies to diagnose, treat and possibly prevent human diseases." DOE's participation is consistent with its mission to study the effects of radiation on humans, and with the computational and technical capabilities of its laboratories.

This paper focuses on budget functions 250 and 270, while the HGP is funded under the budget subfunction for Health Research (552). The HGP is often included with the space station, the Earth Observation System, and the Superconducting Super Collider as one of the "big science" projects of the 1990s. Total cost of the project over 15 years is estimated at about $3 billion (in 1991 dollars), and over $4 billion when adjusted for anticipated increases in the cost of biomedical research. In 1991 the project was funded at a level of $135 million, with $87 million from NIH--an amount equal to 1 percent of its budget.

The HGP has some of the attributes of other large science efforts, most obviously its total cost and long life cycle. It also is a departure from the kind of investigator-initiated research more commonly supported by NIH funding. The project is more centrally coordinated, and some would argue more bureaucratic, than other NIH projects: a research agenda is specified from the top, and investigators are invited to respond. Funds will be allocated to multidisciplinary centers, although about half of the project's spending through 1995 will be directed to individual laboratories and single investigators in the typical manner of biomedical research. It will differ from other NIH projects in that a significant proportion of funds, over 10 percent, will be devoted to technology development. As with the SSC, some key project objectives will require anticipated, but as yet unachieved, technology development.

A major difference between the HGP and other large R&D projects is that the hardware and facilities play a relatively small role in accomplishing project objectives and accounting for project cost. The space station and the SSC require the development of hardware to achieve even minimum objectives. The mission of the SSC, for example, cannot be accomplished by building half of a particle accelerator. The HGP can proceed in a more piecemeal fashion even though the project aspires to a complete mapping and sequencing of the human genome. (The EOS is also a large-hardware project, although less so than the space station or the SSC.)

The HGP also differs from the typical large R&D project in that it will not necessarily dominate the field of research it supports. NIH will be devoting far more of its funds to research related to specific diseases, and genetic therapies are likely to be pursued in many of these programs. NIH spending on research for cancer and AIDS in 1991 was over five times greater in each case than that for the HGP. Even in its peak years anticipated spending for the HGP will not approach the share their agencies' funds accounted for by the three largest federally sponsored R&D projects. Under current plans, the space station and EOS would account for 10 percent and 7 percent of function 250 budget authority in 1995--$2.6 billion and 1.7 billion respectively--while the HGP would account for less than 2 percent of the subfunction 552 in the same year, an anticipated expenditure of $260 million.

The HGP has attributes of big science and some say it may be the precursor of a move toward big science in molecular biology. Yet it differs from the projects classified as big science in budget functions 250 and 270 more than it resembles them.

TABLE 4. NATIONAL SCIENCE FOUNDATION PROJECTS INCLUDED IN THE CBO INVENTORY

Physics

Cornell Electron Storage Ring

Coupled Superconducting Cyclotrons at National Superconducting Cyclotron Laboratory

Indiana University Cyclotron Facility

Long Interferometry Gravity Observatory

Computing Facilities

National Center for Atmospheric Research Scientific Computing Facility

Advanced Supercomputing Centers

NSFNet Computer Network

Magnet Laboratories

Bitter National Magnet Laboratory

Astronomy

National Astronomy and Ionosphere Center Observatories

National Optical Astronomy Observatory

National Radio Astronomy Observatories

Geosciences

Federal Oceanographic Research Fleet

Ocean Drilling Program

Source : Congressional Budget Office.

DOE Projects. Like those of the NSF, the DOE projects are not limited to projects in the Boesman inventory (see Table 5). Most notably, CBO's inventory includes spending for major projects, such as the Isabelle particle accelerator, that were never completed and that were excluded from the Boesman inventory. Also included are projects that are more technological than scientific (such as the Clinch River Breeder Reactor and the Clean Coal Technology Program). DOE provided annual data on its large R&D projects for the 1980-1996 period.

NASA Projects. NASA's large R&D projects dominate most data series measuring large R&D projects in the budget. This dominance holds even if technology projects--for example, the shuttle--are excluded from the inventory. As a group, NASA projects are more expensive than the projects sponsored by all other agencies combined (see Table 6). On a per project basis, average total development spending is almost $600 million for the NASA projects with two or more years of spending that are included in the CBO inventory for 1980 through 1992. For each project in the data set, costs are defined to include development and operations, but not the cost of federal employees, construction of facilities, or space launches.

The Three Largest Projects

This measure of large R&D in the budget includes only the very largest projects--sometimes called megaprojects. For the most part the list consists of the three largest projects funded in functions 250 and 270. In one comparison, however, a fourth project--the Human Genome--is added, to address directly the public concern that the Human Genome and several other very large projects--the space station, the Superconducting Super Collider and the Earth Observation System--will be funded at the expense of many smaller efforts.

The largest project measure is easily constructed, but suffers from several limitations. The same projects need not be the largest year after year. With the exception of the early 1980s, however, the list of largest projects exhibits a reasonable degree of consistency (see Table 7). A second limitation of the largest project measure is its failure to take account of size differences among the largest projects. A glance at the data shows that the multibillion-dollar space shuttle program during the early 1980s, and spending projected for the largest projects--by both NASA and DOE--during the first half of the 1990s, are in a different class from all other projects.

This measure was constructed for the 1980-1991 period using the data from the inventory described above. The series was projected forward through 1996 on the basis of forecasted costs for the three largest planned efforts--the space station, the Earth Observation System, and the Superconducting Super Collider.

The Space Station. The space station is currently the most expensive of the proposed large R&D projects. If the Congress accepts the President's request for 1992, total spending on the project will exceed $7.5 billion through 1992. Additional spending

TABLE 5. DEPARTMENT OF ENERGY PROJECTS INCLUDED IN THE CBO INVENTORY

High Energy Physics Facilities	
Energy Saver	Tevatron I
Tevatron II	Collider Detector at Fermilab
D-Zero Detector at Fermilab	Stanford Linear Detector
Stanford Linear Accelerator Center	Isabelle Accelerator
Stanford Linear Collider	
Nuclear Physics Facilities	
Tandem/AGS Heavy Ion Facility	Argonne Tandem/Linac Accelerator System
BEVALAC accelerator	88-inch Cyclotron
Los Alamos Meson Physics Facility	Holifield Heavy Ion Facility
Bates Linear Accelerator Center	Cyclotron Institute
Continuous Electron Beam Accelerator Facility	Relativistic Heavy Ion Colliding Beam Accelerator
Fusion Facilities	
Princeton Large Torus	Princeton Beta Experiment
Tokamak Fusion Test Reactor	Burning Plasma Experiment
International Thermonuclear Experimental Reactor	Doublet III-D
ALCATOR-C	Tandem Mirror Experiment Upgrade
Mirror Fusion Test Facility	Advanced Toroidal Facility
International Fusion Superconducting Magnetic Test Facility	
Material Science and Engineering Facilities	
Stanford Synchrotron Radiation Laboratory	High Flux Beam Reactor
High Flux Isotope Reactor	6-7 GEV Synchrotron Light Source
1-2 GEV Synchrotron Light Source	National Synchrotron Light Source
Supercomputer Facilities	
National Energy Research Supercomputer Center	Los Alamos National Laboratories Computing and Communications Division (civil only)
Engineering Facilities	
Fast Flux Test Facility	Experimental Breeder Reactor I
Loss-of-Fluid Test Facility	Transient Reactor Test Facility
Zero Power Plutonium Reactor	Calutrons Electromagnetic Isotope Separations Facility
Fuel and Material Examination Facility	Clinch River Breeder Reactor
Clean Coal Technology	

SOURCE: Congressional Budget Office.

TABLE 6. NATIONAL AERONAUTICS AND SPACE ADMINISTRATION PROJECTS INCLUDED IN THE CBO INVENTORY

Space Transportation and Orbital Facilities Development

Space Shuttle
Tethered Satellite
Space Lab
Space Station

Physics and Astronomy

Hubble Space Telescope
Advanced X-Ray Astrophysics Facility
Gamma Ray Observatory
High Energy Astronomy Observatory

Planetary and Solar Missions

Ulysses
Magellan
Pioneer
Galileo
Voyager
Mars Observer
Comet Rendezvous Asteroid Flyby/Cassini

Earth Science and Observation

Upper Atmospheric Research Satellite
Earth Observation System
Ocean Topographic Experiment
Landsat D

Communication

Advanced Communication Technology Satellites

SOURCE: Congressional Budget Office.

TABLE 7. THE THREE LARGEST PROJECTS, 1980 - 1996

1980	Space Shuttle	Clinch River Breeder Reactor	Galileo
1981	Space Shuttle	Clinch River Breeder Reactor	Spacelab
1982	Space Shuttle	Clinch River Breeder Reactor	Hubble Space Telescope
1983	Space Shuttle	Hubble Space Telescope	Clinch River Breeder Reactor
1984	Hubble Space Telescope	Clinch River Breeder Reactor	Spacelab
1985	Hubble Space Telescope	Gamma Ray Observatory	Space Station
1986	Hubble Space Telescope	Space Station	Upper Atmospheric Research Satellite
1987	Hubble Space Telescope	Space Station	Magellan
1988	Space Station	Hubble Space Telescope	Stanford Linear Accelerator Center
1989	Space Station	Hubble Space Telescope	Stanford Linear Accelerator Center
1990	Space Station	Hubble Space Telescope	Superconducting Super Collider
1991	Space Station	Hubble Space Telescope	Superconducting Super Collider
1992	Space Station	Superconducting Super Collider	Earth Observation System
1993	Space Station	Superconducting Super Collider	Earth Observation System
1994	Space Station	Superconducting Super Collider	Earth Observation System
1995	Space Station	Earth Observation System	Superconducting Super Collider
1996	Space Station	Earth Observation System	Superconducting Super Collider

SOURCE: Congressional Budget Office

of about $30 billion could be required through the end of the century, according to NASA's most recent plan for the project. One can argue that the station, like the shuttle system, is not science but a technology program that is only tangentially scientific.[8] It is included in the largest project group because it is directly relevant to other NASA science spending. This point has been made emphatically in current Congressional action on NASA's fiscal year 1992 appropriation, in which House action has funded the space station by freezing science spending in NASA.

The Earth Observation System (EOS). This system features a set of large space platforms, several smaller satellites, a ground-based information system, and a supporting research program. The system is part of a larger effort called Mission to Planet Earth, which adds to EOS a set of smaller satellites, called Earth Probes, and several medium-sized satellites already far along in development but not yet launched. The cost of the EOS is estimated to be $17 billion thorough fiscal year 2000, and as much as $30 billion over the life of the project. The Mission to Planet Earth is itself part of a larger budgetary aggregate called the Global Change Research Program, for which the 1992 budget request included a 24 percent increase to $1.2 billion. Only the funds for EOS proper are included in the largest project series.

The Superconducting Super Collider (SSC). The SSC is a particle accelerator to be built in Texas. The 54-mile racetrack-shaped facility is designed to allow high-energy physicists to discover unknown particles in their investigation of the fundamental structure of matter. Official estimates place its cost at $8.2 billion, but analysts both inside and outside DOE argue that the cost could approach $12 billion. Administration plans call for $5.9 billion to be spent on the SSC through 1996, with $534 million requested for 1992. The Administration currently estimates that nonfederal sources will finance $2.6 billion of the total costs. The state of Texas has committed $1 billion, of which a portion will be spent on in-state activities not included in the SSC total project costs. DOE has not been successful in getting commitments from other countries for more than a small fraction of the remainder. Because of the uncertainties as to the foreign contributions, CBO used the total estimated SSC costs of $8.2 billion, less the net Texas contribution, in its calculations.

Other largest-projects series were constructed for specific agencies to take account of similar resource concentrations within subsets of science and technology spending.

---

8. Concerning the space station in particular, the claim that the project serves no scientific purpose is rejected by the defenders of the effort. For example, Richard Darman, director of the Office of Management and Budget, holds that the argument that space exploration and the space station are not of value to science is incorrect because it ignores the "extent to which exploration can enable, stimulate and inspire science." Statement by Richard Darman before the Committee on Science, Space and Technology of the House of Representatives, June 4, 1991.

Fields of Research

The fields-of-research measure of large R&D embraces all of the spending for a research field that is dominated by big instruments or facilities. For example, the cost of building and operating particle accelerators has dominated high-energy physics spending. Most of the research in this field relies on the results of experiments using accelerators that are included in the large R&D project inventory, even if funding of particular research is not directly tied to funding for a particle accelerator.[9] The rationale for the fields-of-research measure is that the institutions that control large instruments or facilities tend to drive the research in such fields. A strength of the measure is that it can reflect the position of fields that are small in budgetary terms yet dominated by large instruments. Its corresponding weakness is its failure to capture the interaction between areas of research--for example, the effects of developing the space shuttle on disciplinary funding in the NSF. An additional problem with the fields-of-research measure is that not all research in every funding category dominated by large instruments is related to these instruments. Consequently, it is by far the largest of the measures (see Table 3).

The R&D Plant Approach

A final measure of large R&D projects focuses on spending for the R&D plant--the building, equipping, and maintaining of facilities--as a defining characteristic of large R&D. This approach is potentially useful in examining the claim that spending for R&D is undertaken not only to further science and technology objectives, but also to provide the local and immediate benefits of construction. A drawback of the series is that it does not provide a consistent measure of large R&D projects: DOE's big projects, for instance, have a larger element of construction in them than do NASA's, which are dominated by development costs. DOE's plant share averages close to 15 percent of all its R&D, while NASA's average is no more than half that.[10] In addition, funds for maintenance as an activity, like funds for small R&D efforts, may be traded off against development funds for large projects if fiscal constraints are present.

---

9. For instance, a theoretical physicist may take published reports of empirical work from a large accelerator, make theoretical refinements, and put forward a hypothesis that requires yet another large instrument to test. In some sense, the existence of an active field justifies spending on big instruments.

10. In addition, some DOE projects are covered by cooperative agreements with nonfederal entities. Such projects, most notably the Clinch River Breeder Reactor, are not included in the R&D plant series.

SPENDING AGGREGATES

CBO used two types of aggregate spending measures in its analysis of historical and projected trends in the various measures of large R&D projects; these are the denominators in the ratios discussed in the next chapter. The first type of aggregate includes three time series for science spending:

- All civilian R&D budget authority;
- Functions 250 and 270 budget authority; and
- Agency budget authority.

Two alternative projections of these aggregates are used for the period 1992 through 1996, one set based on the President's budget request and the other on the CBO baseline.[11] The second type of aggregate is a single measure of the broad class of spending of which science spending is a part: domestic discretionary spending.

All Civilian R&D

Civilian R&D is the conventional base against which to compare spending for large R&D projects. CBO's measures for the 1980s and early 1990s include both operations and construction. CBO estimated civilian R&D spending in the President's request for 1992 through 1996, based on the projected growth of the budget functions and agencies undertaking R&D that were included in the request.

Function 250 and 270 Budget Authority

Functions 250 and 270 account for most federal civilian R&D outside of the biomedical fields. Function 250 is the general science, space and technology function; 270 accounts for energy. These functions include the agencies that fund most of the R&D outside health and defense: the Department of Energy's civilian R&D, the National Aeronautics and Space Administration's nonaeronautical R&D; and all of the National Science Foundation's R&D. Most important, the major large instrument projects all are contained within these two functions, most of them within function 250. The major drawback of this series is that it contains many NASA and

---

11. The Administration and CBO projections of spending in these categories differ substantially. The Administration projections include funding for its menu of programs, whereas CBO's is a baseline projection that provides just enough additional funds to compensate for inflation, thus maintaining a fixed level of real resources committed to an area. In the case of function 250 (General Science, Space and Technology), by 1996 the Administration's program is 25 percent higher than CBO's baseline. In the case of the energy function (270), the Administration wants to shift resources out of these programs, and consequently its forecast for 270 is 25 percent lower than the CBO baseline.

DOE non-R&D operations. In fact, NASA non-R&D operations account for between a third and a half of the function 250 series.

Agency Budget Authority

Because agencies are in charge of administering these programs, a comparison of how the projects fare in terms of annual agency budgets over time can show their effect on agency priorities. The agencies examined in this paper are NSF, DOE, and NASA. In keeping with the paper's focus on civilian R&D, only DOE's civilian budget authority is presented. DOE budget authority is also presented in net terms, because some DOE activities generate receipts--for example, the power marketing authorities.

Domestic Discretionary Budget Authority

Finally, the paper compares spending for large R&D projects with domestic discretionary spending to show the relation between this and other types of federal spending in the past (and, for the Administration's proposed program, in the first half of the 1990s). Because a historical data series for domestic discretionary budget authority is not readily available, CBO used outlay data to estimate domestic discretionary budget authority for 1980 - 1990 (see Appendix). The projected series for 1992 through 1996 is CBO's reestimate of the President's budget request for domestic discretionary budget authority. This series conforms closely to the caps for domestic spending mandated under the Budget Enforcement Act of 1990 for fiscal years 1992 and 1993, and is consistent with the caps on all discretionary spending through 1995.[12]

12. The Budget Enforcement Act of 1990 created three categories of discretionary spending: domestic, defense, and international. After 1993, the caps that the act imposed on each category separately will be merged into a unified cap for the three categories as a whole.

CHAPTER III
COMPARING PAST AND PROJECTED SPENDING ON LARGE CIVILIAN R&D PROJECTS

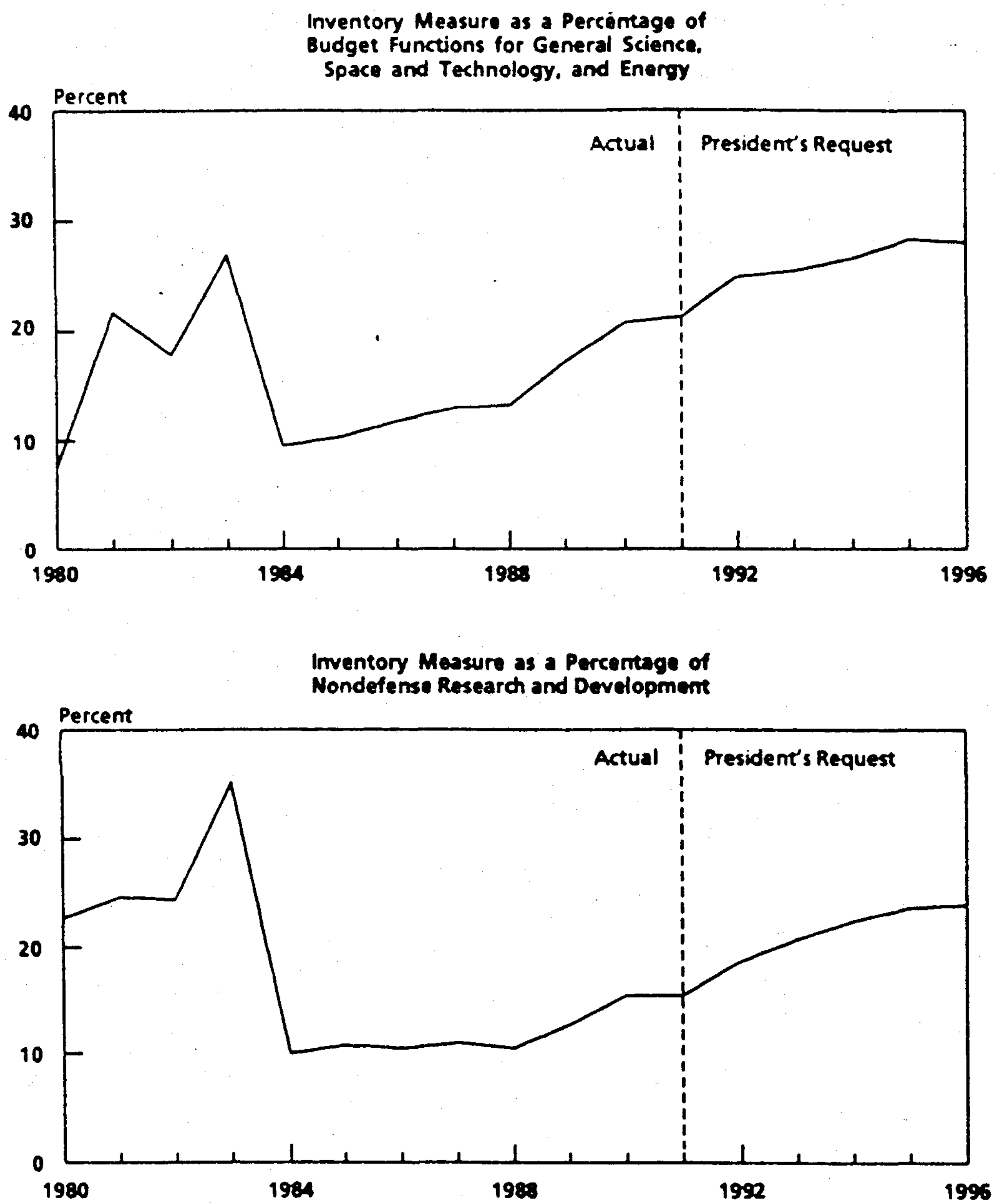
If the Congress adopts the Administration's spending plan for the 1990s, the share of civilian R&D accounted for by the three largest projects will double, rising to 15 percent by 1996. The three projects will increase their share of all domestic discretionary spending from 1.1 percent in 1990 to almost 3 percent by 1996. Under the Administration's plan, increased spending for large projects will be accompanied by real growth in other R&D spending. A comparable peak in spending on large R&D projects occurred in the early 1980s, but at that time other R&D spending did not increase. If the Congress does not fully fund the Administration's program, choices will have to be made once again between large R&D projects and all other R&D.

THE TREND IN THE 1980s

Spending on large civilian R&D projects, led by the NASA space shuttle, reached its peak in relation to all nondefense R&D project spending early in the 1980s. At its peak, the inventory of large R&D projects accounted for over a third of all civilian R&D spending (see Figure 2). The three largest projects received just over a quarter of the budget authority granted to civilian R&D (see Figure 3). The final years of R&D funding for the space shuttle during the early 1980s dominate both measures, accounting for over 95 percent of budget authority for the three largest projects. This peak occurred at a time when all civilian R&D was rising only slowly and when combined budget authority for functions 250 and 270 was falling (a consequence of the shift away from energy as a national priority).

A somewhat different picture is presented if one removes spending on the space shuttle from the comparison. Recent data for R&D spending in the early 1980s no longer include the last several years of spending on development for the shuttle on the basis that the shuttle was not so much an R&D project as an engineering project and a capital investment in technology likely to serve defense and commercial interests as well as the scientific community. Removing the shuttle from the CBO inventory data series, as in Figure 4, results in a steady increase in the share of large R&D project spending throughout the 1980s, without a sharp spike early in the decade. The shuttle influence is present nevertheless; the increase is driven by NASA spacecraft development projects that proliferated and grew as the budgetary resources devoted to the shuttle stabilized. CBO retained spending on the shuttle in its measures of large R&D projects during the early 1980s, because development spending for the shuttle is comparable to that for the space station in the early 1990s, which is currently included in published R&D data series. Moreover, the shuttle is the large R&D project most prominently cited as having crowded out other activities.

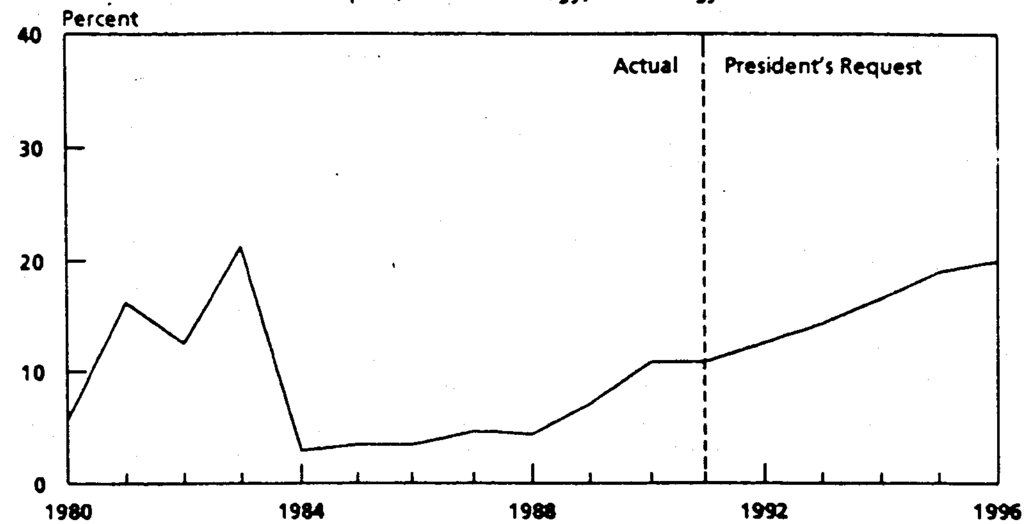
Figure 2.
Spending on Large Research and Development Projects (Inventory Measure)as a Percentage of Budget Functions for General Science,Space and Technology, and Energy and of Nondefense Research and Development, 1980-1996



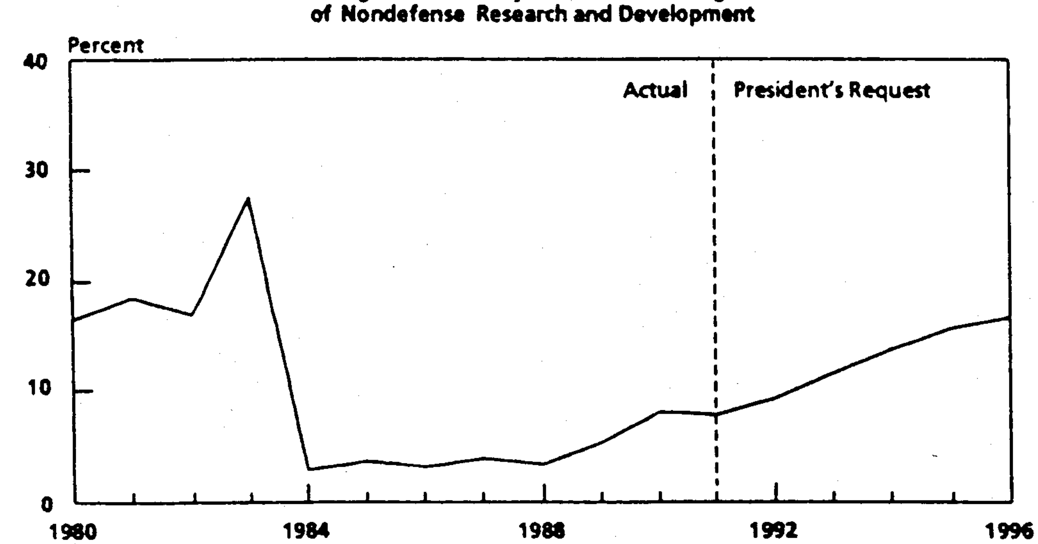
SOURCE: Congressional Budget Office.

Figure 3.
Spending on the Largest Three Research and Development Projects as a Percentage of Budget Functions for General Science, Space and Technology, and Energy and of Nondefense Research and Development, 1980-1996

Largest Three Projects as a Percentage of Budget Functions for General Science, Space, and Technology, and Energy

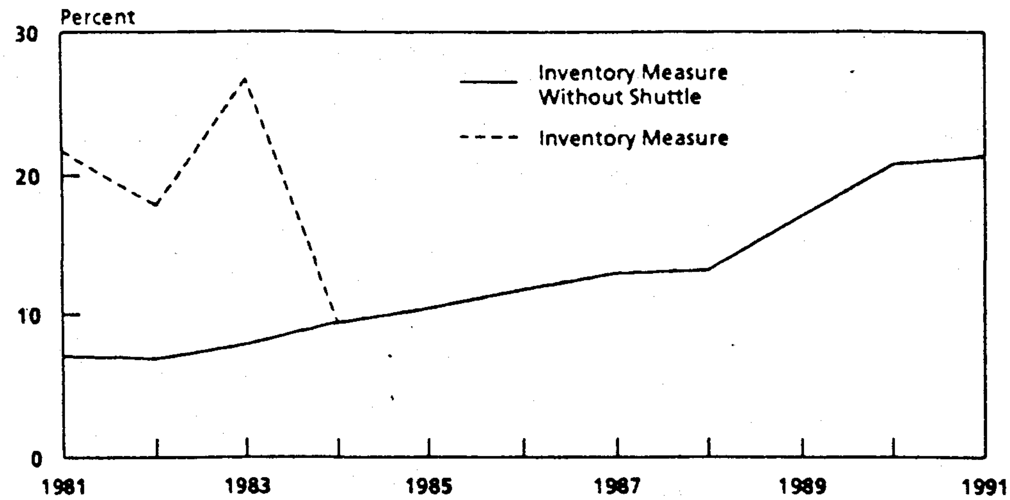


Largest Three Projects as a Percentage of Nondefense Research and Development



SOURCE: Congressional Budget Office.

Figure 4.
Effects of the Space Shuttle on the Inventory Measure of Large Research and Development Spending, 1981-1991



SOURCE: Congressional Budget Office.

Other measures of large R&D project spending tell the same story from a different perspective. In the first three years of the 1980s, the share of agency-level research and development accounted for by R&D plant fell for DOE, NASA, and NSF (see Figure 5). In NASA's case, the priority granted the shuttle probably explains this decline. In the case of DOE, the decline probably reflects downsizing of the overall national R&D effort in the energy field. Beginning in 1984, however, the share of each agency's R&D accounted for by plant began to move upward--a trend that has continued. The research field measure of large R&D project spending also ended the decade of the 1980s on the rise, but only after a longer period of decline than any of the other three measures (see Figure 6).

PROJECTIONS FOR THE 1990s

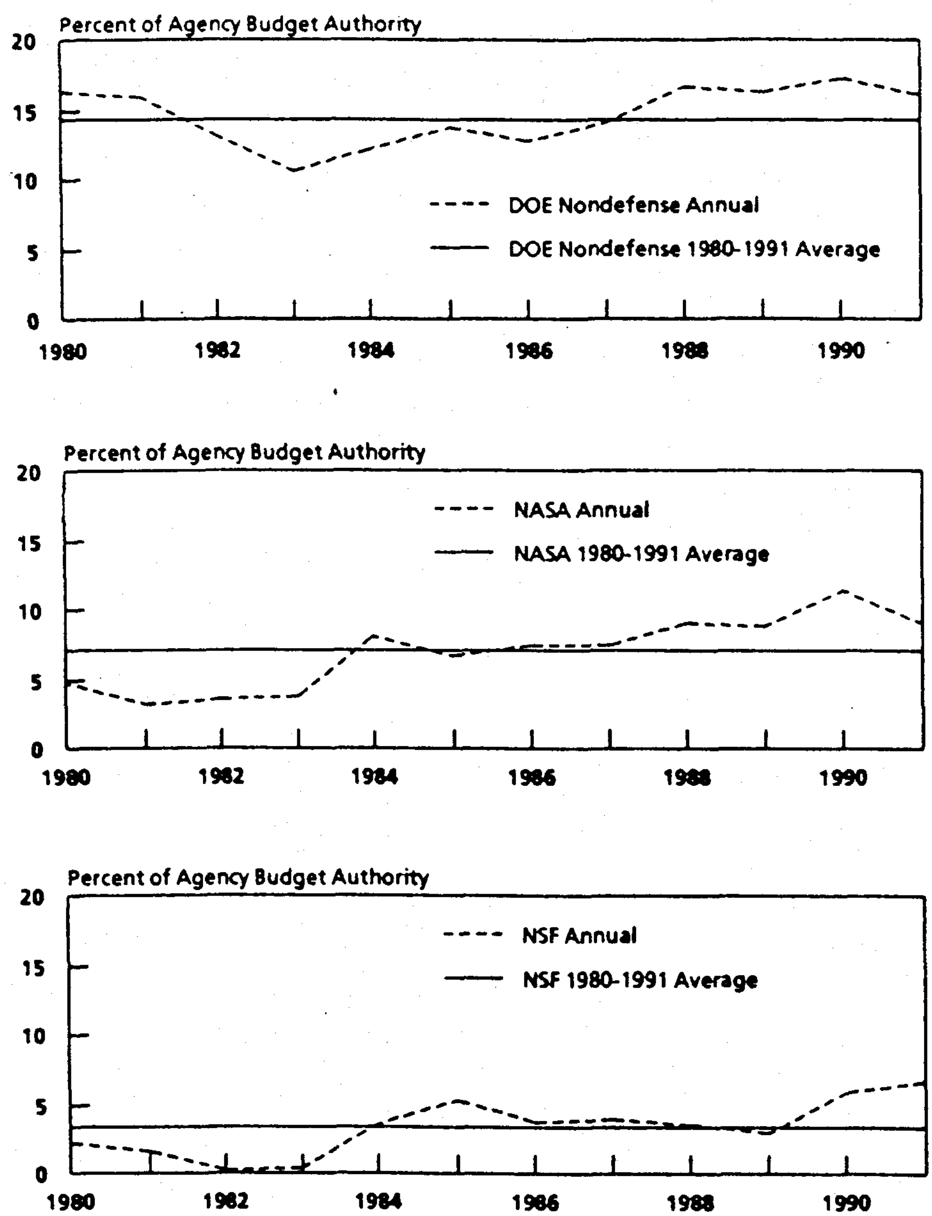
If the Administration's program is enacted, large R&D projects would consume an increasing share of domestic discretionary spending during the first half of the 1990s. By the inventory measure, the share of big R&D projects would increase from 2 percent of all domestic discretionary budget authority in 1990 to almost 4 percent of all such spending in 1996 (see Figure 7). The very largest projects would enjoy an even greater increase in their share: the three biggest science and technology projects would see their share more than double from 1.1 percent to 2.8 percent of all domestic discretionary spending.

The largest three projects would also see an increase in their share of civilian R&D, even though planned spending for civilian R&D would be rising overall (see Figure 8). In 1990, the three largest projects accounted for slightly more than 8 percent of civilian R&D, but by 1996 they would account for over 15 percent.[13] The inventory measure would experience a similar rise from 16 percent to 22 percent of civilian R&D. Equally dramatic as an indicator of the increasing share of large R&D projects in science and technology funding is the projected increase of the largest three projects' share of budget function 250 (General Science, Space and Technology) to 24 percent in 1996. The similarity of patterns among these different aggregates indicates strongly that under the Administration's program large R&D projects would occupy an increasing share of an increasing part of the budget.

On an agency basis, the large R&D projects are also projected to show an increase in their share of budget authority. The three largest NASA projects would take as much as a quarter of the agency's budget, though this would still be much less than in the early 1980s when the shuttle was being developed. At that time, large projects required half of NASA resources. The largest DOE projects, led by the SSC, would almost triple their share of DOE budget authority between 1990 and 1996,

13. If planned spending for the Human Genome project is added to that for the three largest projects in CBO's inventory, by 1996 the Human Genome, the space station, the Superconducting Super Collider, and the Earth Observation System would account for 16 percent of projected spending for civilian R&D.

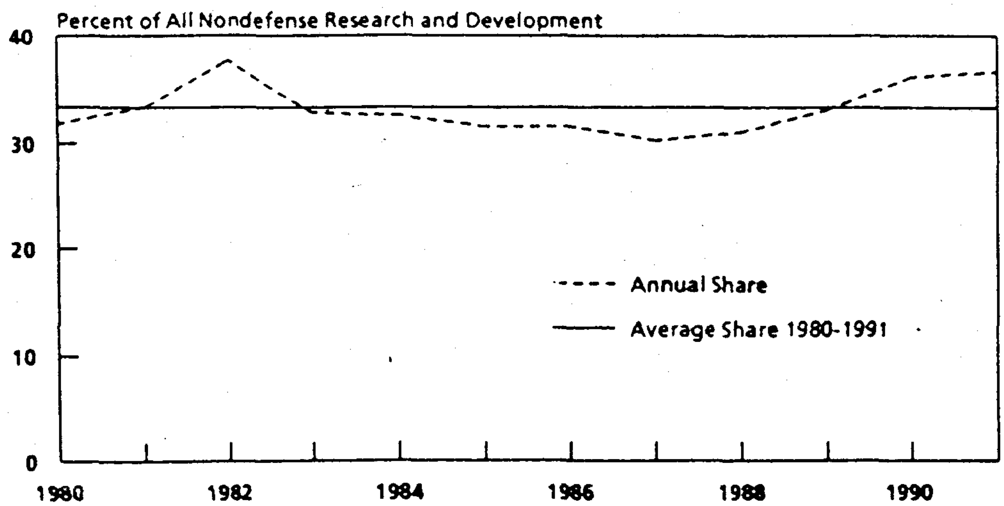
Figure 5.
Spending on Research and Development Plant
by Three Agencies, 1980-1991



SOURCE: Congressional Budget Office.

NOTE: DOE = Department of Energy; NASA = National Aeronautics and Space Administration; NSF = National Science Foundation.

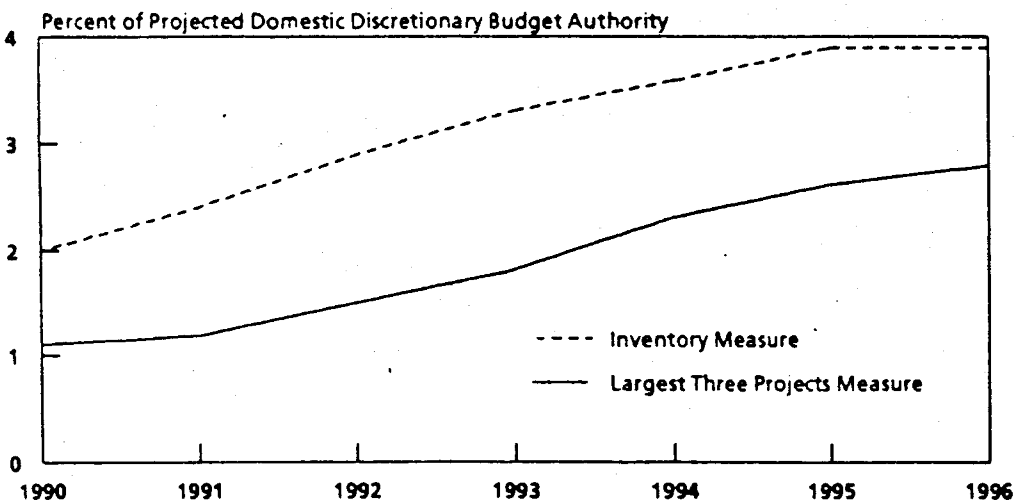
Figure 6.
Spending on Fields of Research Dominated by Large Instruments and Facilities as a Percentage of All Nondefense Research and Development, 1980-1991



SOURCE: Congressional Budget Office.

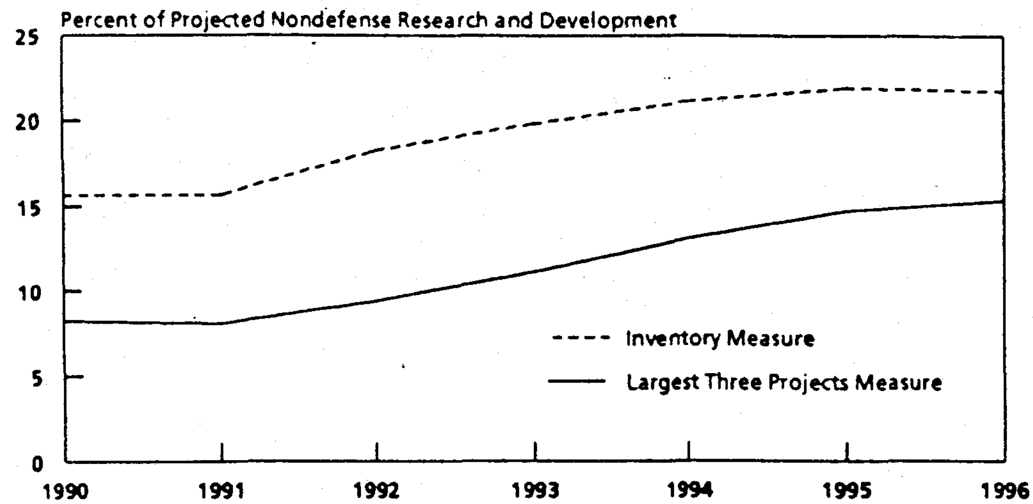
NOTE: The fields-of-research measure of large research and development embraces all of the spending for research fields dominated by big instruments or facilities.

Figure 7.
President's Request for Spending on Large Nondefense Research and Development Projects as a Percentage of Domestic Discretionary Budget Authority, 1990-1996



SOURCE: Congressional Budget Office.

Figure 8.
President's Request for Spending on Large Nondefense Research and Development Projects as a Percentage of All Nondefense Research and Development Spending, 1990-1996



SOURCE: Congressional Budget Office.

absorbing 28 percent of budget authority by 1996 (see Table 8). The share of NSF funds consumed by their inventory of large projects is projected to remain constant at roughly 15 percent.

The increase in the share of the biggest projects is partly accounted for by their growth in absolute terms. Budget authority for the largest three projects is projected to grow at an average rate of 14 percent a year through 1996 even after adjusting for inflation. The broader inventory measure registers a more modest 9 percent real growth a year during the 1990-1996 period (see Table 9).[14] Even at its height in 1996, however, the inflation-adjusted spending projected for the largest three programs would be less than what was spent on the largest three programs in 1983.

In absolute terms, the increases for the largest NASA projects would be much larger than those for DOE projects. NASA's three largest projects would increase in annual budget authority by $3.1 billion between 1990 and 1996, rising from $2.0 billion in 1990 to $5.1 billion in 1996. DOE's three largest projects would increase by less than one-third that amount, or $0.9 billion, to reach $1.4 billion in 1996. The more comprehensive DOE inventory of large projects would rise by roughly $1.2 billion over the same period.

CBO's budgetary measures of large R&D project spending use the cost forecasts the sponsoring agencies provide. Should these prove optimistic, then the Congress will face difficult choices. Under the Budget Enforcement Act, spending to cover overruns and maintain project schedules must come from reductions in other domestic spending. Reducing other domestic spending unrelated to science and technology would grant even higher priority to the area than that proposed by the Administration. Fully funding overruns so as to maintain project schedules for large R&D projects at the expense of other science spending would repeat what appears to have happened in the early 1980s. This would be the outcome most feared by those in the scientific community not directly associated with the largest projects. An internal DOE evaluation placing the total cost of the Superconducting Super Collider at almost 45 percent above the official estimate of $8.2 billion illustrates the possible magnitude of overruns in large projects.[15] Similarly, the General Accounting Office has questioned NASA's current cost estimate for its space station program.[16]

---

14. Some part of the difference in inflation-adjusted growth rates is an artifact of CBO's choice of projects for the inventory. Upcoming projects may have been overlooked.

15. Department of Energy, Independent Cost Estimating Staff, "Independent Cost Estimate for the Superconducting Super Collider" (September 1990).

16. Statement of Charles A. Bowsher before the Subcommittee on Government Activities and Transportation of the House Committee on Government Operations, May 1, 1991.